

Appl. No. 10/030,153  
Amendment dated: May 10, 2004  
Reply to OA of: February 12, 2004

### **REMARKS**

Applicants appreciate the Examiner's helpful suggestions for avoiding the objection to claim 1. Applicants have amended the claim in accordance with the Examiner's request and therefore most respectfully request that this objection be withdrawn.

Claim 3 is objected to and has been amended to overcome this objection. Accordingly, it is most respectfully requested that this objection be withdrawn.

The rejection of claims 1-4 under 35 U.S.C. 102(e) as being anticipated by Kim et al. has been carefully considered but is most respectfully traversed. In this regard, Applicants wish to direct the Examiner's attention to MPEP § 2131 which states that to anticipate a claim, the reference must teach every element of the claim.

"A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference." *Verdegaal Bros. v. Union Oil Co. of California*, 814 F.2d 628, 631, 2 USPQ2d 1051, 1053 (Fed. Cir. 1987). "The identical invention must be shown in as complete detail as is contained in the ... claim." *Richardson v. Suzuki Motor Co.*, 868 F.2d 1226, 1236, 9 USPQ2d 1913, 1920 (Fed Cir. 1989). The elements must be arranged as required by the claim, but this is not an *ipsissimis verbis* test, i.e., identity of terminology is not required. *In re Bond*, 910 F.2d 831, 15 USPQ2d 1566 (Fed.Cir. 1990).

The following is a comparison between the presently claimed invention and Kim et al reference from which it is clear that the reference does not anticipate the presently claimed invention.

Kim et al. relates to a biofuel cell comprising a cathode, an anode, conductive media thereof, an ion exchange membrane interposed between the cathode and the anode, and a microbial catalyst around the anode region wherein a metal salt reducing bacterium (a single species of an electrochemically active bacterium, e.g., IR-1 or AJ-2), as the microbial catalyst, is fed into an anode compartment. In contrast, the presently

claimed invention relates to a biofuel cell comprising an anode compartment wherein sludge and wastewater is added to the anode compartment.

Hereinafter, the distinctions of the present invention from Kim et al. will be discussed in terms of the object, constitution and effects thereof.

#### Difference in the object of both inventions

Kim et al. provides a **mediator-less biofuel cell** in which organic or inorganic matter contained in wastewater is used as a fuel, **and an operation thereof**. In contrast, the present invention further provides a method for **densely culturing electrochemically active bacteria present in active sludge and wastewater**.

Both inventions share the provision of **a biofuel cell** in common. However, the biofuel cell of Kim et al. is provided **for the purpose of generating an electric current** without an electron transfer mediator, whereas the biofuel cell of the present invention is provided **for the purpose of densely culturing electrochemically active bacteria present in sludge and wastewater**. Accordingly, the present invention and the Kim et al. are clearly distinguished from each other in terms of the object of both inventions.

More specifically, the biofuel cell of Kim et al. is intended to generate a large quantity of electricity, whereas the biofuel cell of the present invention is intended to **densely culture electrochemically active bacteria, which is not disclosed in Kim et al. at all**. Therefore, the object of the present invention cannot be easily anticipated from Kim et al. by one skilled in the art.

#### Difference in the constitution of both inventions

The biofuel cell of Kim et al. comprises a cathode, an anode, conductive media thereof, an ion exchange membrane interposed between the cathode and the anode, and a microbial catalyst around the anode region wherein the microbial catalyst is a metal salt reducing bacterium. In contrast, the biofuel cell of the present invention includes a cathode compartment, an anode compartment and an ion exchange membrane interposed between the two compartments wherein the two compartments

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contain a conductive medium and the anode compartment contains active sludge and wastewater.

Both inventions are highly distinguished from each other in terms of the constitution thereof. Hereinafter, the distinctions of the present invention from Kim et al. are explained **in terms of the basic structure and the kind of microorganisms and fuel used.**

First, there is a difference in the basic structure of the biofuel cells of both inventions.

The biofuel cell of Kim et al. uses **a single species of microorganism and a particular fuel without a mediator**, whereas the biofuel cell of the present invention uses **sludge and wastewater without a mediator**.

Second, both inventions are clearly different in the kind of microorganisms used.

The biofuel cell of Kim et al. uses **IR-1 (KCTC 88753P) or AJ-2 (KCTC8752J), both of which are isolated Shewanella sp.,** whereas the biofuel cell of the present invention **utilizes electrochemically active bacteria contained in various organic substances such as wastewater**, instead of a particular microorganism as in Kim et al. That is, electrochemically active bacteria present in sludge and wastewater fed to the anode compartment grow in the anode compartment and adhere to the anode arranged in the anode compartment, thus having an electrochemical activity. This disclosure is found in the detailed description of the present invention. Accordingly, both inventions are apparently different in the kind of the microbial catalyst used. In addition, Kim et al. does not disclose the microbial catalyst used in the present invention, and thus a person skilled in the art cannot easily anticipate the constitution of the present invention from Kim et al.

Finally, both inventions are clearly different in the kind of fuel used. The biofuel cell of Kim et al. uses **at least one material selected from pyruvate, lactate and citric acid as a fuel**. In contrast, the biofuel cell of the present invention uses **wastewater alone** without the use of a particular fuel.

As discussed above, both inventions are highly distinguished from each other in terms of the constitution thereof and the primary features, i.e. the kind of microorganisms and fuel used.

Difference in the effects of both inventions

First, the biofuel cell of Kim et al. uses a particular species of microorganism. Accordingly, **the microorganism needs to be frequently replaced or repaired** in order to continuously use the biofuel cell of Kim et al. As a result, isolation and purification of the microorganism is necessary, which causes **high production costs and inefficient measurement of electric current**.

In contrast, since the biofuel cell of the present invention utilizes bacteria contained in wastewater or organic substances, **there is no need to separately purify bacteria in order to obtain the bacteria in a sufficient quantity**. The biofuel cell of the present invention can be operated without additional addition of bacteria and allows the activity of the bacteria to be suitably maintained depending on the nature of the wastewater. In addition, since the biofuel cell of the present invention does not require the replacement of microorganisms, it can be installed at low cost in a simple manner.

Second, the present invention suggests a method for densely culturing electrochemically active bacteria present in active sludge and wastewater. This method greatly increases the operational stability of the biofuel cell. This disclosure can be seen throughout the specification and drawings of both inventions. Specifically, the biofuel cell of Kim et al. is operated for a maximum of 24 hours, but the biofuel cell of the present invention can be operated for 30 days or more.

**In conclusion, since the biofuel cell of the present invention does not require the replacement of microorganisms and the use of a separate electron transfer mediator or transducer, it is fabricated in a simple manner and is thus economically advantageous.**

As explained above, the present invention is different from Kim et al. in terms of the object of both inventions. In addition, the present invention is recognized to be technically difficult in achieving its constitution and to have considerable effects, compared to Kim et al. Therefore, as would be appreciated by one of ordinary skill in the art the presently claimed invention is not anticipate by Kim et al. Accordingly, it is most respectfully requested that this rejection be withdrawn.

The additional references cited on the Form PTO-892, have not been applied against any of the claims and do not render obvious or anticipate any of the claimed subject matter. The Helmuth reference relates to a biochemical fuel cell using bacteria and photosynthesis, whereas the present invention relates to a biofuel cell comprising an anode compartment wherein the anode compartment contains sludge and wastewater.

That is, the biochemical fuel cell of Helmuth is operated by irradiating light onto a medium supplemented with a culture of a single species of microorganism to conduct photosynthesis. The biofuel cell of the present invention is operated by generating an electric current using electrochemically active microorganisms present in wastewater without artificial addition of microorganisms, unlike conventional biofuel cells. This operational principle is not described in Helmuth.

The Bennetto et al. relates to a method of controlling the operation of a microbial fuel cell by adding HNQ as an electrochemical mediator to a single species of microorganism and a particular substrate. In contrast, the biofuel cell of the present invention is operated using electrochemically active bacteria contained in a mixture of microorganisms (sludge) and mixed media (wastewater) without a mediator. Accordingly, both inventions are apparently distinguished.


As explained above, the present invention is different from Bennetto et al. in terms of its constitution, in particular, the primary features, i.e. the kind of microorganisms used and operational manner.

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In view of the above comments and further amendments to the claims, favorable reconsideration and allowance of all of the claims now present in the application are most respectfully requested.

Respectfully submitted,

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